EXHIBIT B

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United States Patent [19]

Davis et al.

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[54] **ROTATIONAL CONTROL APPARATUS**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 254,290, Jun. 6, 1994, which is a continuation-in-part of Ser. No. 201,783, Feb. 25, 1994.

[51] **Int. Cl.**[6] **F16D 25/0638**; F16D 67/04; F16D 47/00; F01P 7/02

[52] **U.S. Cl.** ..... **192/18 A**; 192/48.2; 192/48.4; 192/48.91; 192/70.12; 192/113.21; 192/113.23; 310/105

[58] **Field of Search** ..... 192/18 A, 48.2, 192/48.91, 70.12, 113.21, 113.23, 87.17, 87.16, 113.2, 113.22, 113.36, 48.3, 48.4; 310/105

[56] **References Cited**

U.S. PATENT DOCUMENTS

726,536	4/1903	Holz .	
1,136,279	4/1915	Severy	192/48.2 X
1,306,784	6/1919	Soames et al. .	

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

0202749	11/1986	European Pat. Off. .	
2355205	1/1978	France .	
2375494	7/1978	France .	
671285	2/1939	Germany .	
1020242	11/1957	Germany	192/48.2
1020243	11/1957	Germany .	
1188191	3/1965	Germany .	
1613060	1/1971	Germany .	
2653459	6/1978	Germany .	
2821973	11/1978	Germany .	
3203143	8/1983	Germany .	
3443523	6/1986	Germany .	
4207710	9/1993	Germany .	
59-226721	12/1984	Japan .	
61-130630	6/1986	Japan .	
390375	8/1965	Switzerland .	
1077724	8/1967	United Kingdom .	
1268444	3/1972	United Kingdom .	
2054279	2/1981	United Kingdom .	

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[57] **ABSTRACT**

Rotational control apparatus in the forms of fan clutches (A, A') are shown including an eddy current drive (**224**). Specifically, the eddy current drive (**224**) includes a plurality of permanent magnets (**226**) mounted circumferentially spaced and with alternating polarity by a holder (**228**) to the input or output of the clutch (A, A') and a magnetically conductive ring (**242**) mounted to the other of the input or output of the clutch (A, A'). Thus, the output portion and the fan blades mounted thereto are driven at engine speeds when the clutch (A, A') is air actuated and are driven at a rotational speed less than engine speed by the eddy current drive (**224**) when the clutch (A, A') is not air actuated and without separate controls for the eddy current drive (**224**). A housing (**62**) comprises the output portion of the clutch (A) which is rotatably mounted by a bearing (**58**) to the hub portion (**24**) of a friction disc (**28**) which comprises the input portion of the clutch (A). In other forms, the output portion of the clutch (A') is in the form of a hub (**20'**) rotatably mounted on a stationary shaft (**24'**) and the input portion is in the form of a sheave (**50'**) rotatable relative to the hub (**20'**) and the shaft (**24'**). Additionally, the hub (**20'**) can be braked by rotatably relating the hub (**20'**) to the shaft (**24'**). In one form, the friction ring (**252**) includes peripheral gear teeth (**256**) in slideable gearing relation with gear teeth (**250**) formed in the housing (**62**) and is formed of fiber brake material to act as a dampener between the friction disc (**28**) and the housing (**62**) to absorb torsional vibration.

32 Claims, 6 Drawing Sheets